

occurred with a rising river, while in the flood of the present year the Mississippi had begun to fall from Cairo to Vicksburg before the most disastrous crevasses occurred. The Pointe Coupee levees protected the sugar belt and were the most important in the state of Louisiana, or in the entire Mississippi system. The principal of these was the great Morganza levee, which was the first to go along the Pointe Coupee front; it was closely followed by numerous other breaks, and practically the entire parish was flooded, save sections protected by interior levees. The vast volume of water which escaped through the Pointe Coupee breaks caused a marked fall in the river below. The flooded area in Louisiana was probably not less than 5,000 square miles. The Austin crevasse overflowed about 10,000 acres of cleared land in Mississippi, and on the Arkansas side of the river about 10,000 acres were inundated.

The Ohio River fell below the danger line at Louisville, Ky., during the 1st, and by the 23d it was again confined to its banks at Paducah, Ky. On the 9th a large part of Johnstown, Pa., was flooded. The excessive rainfall of the latter part of the month caused disastrous floods in north-central Texas, more especially along the Trinity River.

OPENING OF NAVIGATION.

Lake Superior.—Boats arrived and departed from Duluth, Minn., and Marquette, Mich., during the latter part of the month, and Mackinaw Straits, which were closed by ice on the 1st, were open to navigation on the 11th.

Green Bay.—On the 11th the bay was free of ice as far as could be seen from Green Bay, Wis., and on the night of this date the lights at Grassy Island and Long Tail Point were lighted for the first time this season.

Sault de Ste. Marie River.—A steam barge arrived at Sault de Ste. Marie, Mich., 20th; this was the first arrival of the season.

Mississippi River.—The first through boat of the season from the south arrived at Saint Paul, Minn., 24th. The first boat of the season passed up the river at Dubuque, Iowa, on the 1st.

Missouri River.—At Fort Buford, N. Dak., the ice began to break up on the 5th, and by the 8th the river was clear of ice. At Fort Yates, N. Dak., the ice broke up on the morning of the 4th, and the river was clear of ice on the 10th. At Fort Sully, S. Dak., the river was clear of ice on the 6th, but the water was so low as to seriously interfere with navigation.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were observed during the month as follows: 7th, South Canisteo, N. Y. 8th, Fort Custer, Mont., and Greenville, Pa. 11th, South Canisteo, N. Y. 14th, Clinton, Iowa; Glasgow, Wis., and Rolling Green, Minn. 15th, Saint Vincent, Minn. 16th, Boston, Mass., and Eastport, Me. 17th, Fort Custer, Mont., and Glasgow, Wis. 22d, Lyons, N. Y. 24th, Berrien Springs, Mich. 26th, Middleburgh, N. Y. 27th, Oskaloosa, Iowa.

Fort Custer, Mont., 8th: a faint auroral light was observed at 10.45 p. m., and lasted until 11.10 p. m. It was in the form of a diffused light located 20° west of north. Another aurora was observed between 10.15 p. m. and 11.15 p. m., 17th. It consisted of an irregular pale arch of light in the northern sky, and rose to about altitude 45°.

Saint Vincent, Minn.: an auroral display, consisting of a pale diffused light, was observed from 9.40 p. m. to 11.45 p. m., 15th; it extended from azimuth 195° to 240° and to altitude 10°.

THUNDER-STORMS.

The more severe thunder-storms of the month are described under "Local storms." East of the Rocky Mountains thunder-storms were reported in the greatest number of states and territories, twenty-four, on the 9th; in eighteen on the 27th; in seventeen on the 8th, 14th, 26th, and 30th; in from eleven

to sixteen, inclusive, on the 2d, 3d, 4th, 7th, 13th, 22d to 25th, 28th, and 29th; in from five to ten, inclusive, on the 1st, 6th, 10th, 12th, and 15th to 21st; and in two on the 5th and 11th. There were no dates on which thunder-storms did not occur east of the Rocky Mountains.

East of the Rocky Mountains thunder-storms were reported on the greatest number of dates, twenty-four, in Texas; on nineteen in Michigan; on sixteen in Kansas; on from eleven to fifteen, inclusive, in Arkansas, Florida, Illinois, Iowa, Louisiana, Minnesota, Mississippi, Missouri, New York, North Carolina, Ohio, and Tennessee; and on from one to ten, inclusive, in Alabama, Connecticut, North Dakota, District of Columbia, Georgia, Indiana, Indian Territory, Kentucky, Maryland, Massachusetts, Montana, Nebraska, New Hampshire, New Jersey, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Vermont, Virginia, West Virginia, and Wisconsin. Delaware and Maine were the only states in which thunder-storms were not reported during the month. West of the Rocky Mountains thunder-storms were reported as follows: Arizona, 1st, 10th, 11th, 15th, 22d, and 23d; California, 18th and 23d; Colorado, 1st, 19th to 24th, 26th and 30th; Idaho, 30th; Nevada, 26th, 29th, and 30th; New Mexico, 15th, 16th, 18th to 21st, 24th, 27th, and 29th; Utah, 22d, 23d, and 24th; Washington, 11th and 25th; Wyoming, 19th, 21st, 22d, and 30th. There were no states or territories west of the Rocky Mountains in which thunder-storms were not reported.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Rain on the 28th broke the drought which had prevailed in the vicinity of Savannah, Ga., during the last three months. The long drought in the Rio Grande Valley was broken by heavy rain on the 17th. The prevailing drought in the vicinity of Key West, Fla., was beginning to be severely felt at the close of the month. Reports from Huron, S. Dak., state that the continued drought was damaging sprouting grain, and that rain was badly needed in that section.

HALOS.

Solar and lunar halos were reported in New England and the middle Atlantic states on twenty-four dates; 75 per cent. of the halos were attended on the first day, 71 per cent. were followed on the second day, and 67 per cent. were followed on

the third day by rain or snow. In the south Atlantic states halos were reported on thirteen dates; 62 per cent. of the halos were attended on the first day, 70 per cent. were followed on the second day, and 46 per cent. were followed on the third day by rain. In the Gulf States halos were reported on thirteen dates; 62 per cent. of the halos were attended on the first day, 54 per cent. were followed on the second day, and 46 per cent. were followed on the third day by rain. In the Mississippi and Ohio valleys halos were reported on twenty-three dates; 74 per cent. of the halos were attended on the first day, 74 per cent. were followed on the second day, and 65 per cent. were followed on the third day by rain or snow. In the Lake region halos were reported on twenty-one dates; 67 per cent. of the halos were attended on the first day, 62 per cent. were followed on the second day, and 67 per cent. were followed on

the third day by rain or snow. In the Missouri Valley halos were reported on eighteen dates; 61 per cent. of the halos were attended on the first day, and 61 per cent. were followed on the second and third days by rain or snow. In the Rocky Mountain and plateau regions halos were reported on thirteen dates; 33 per cent. of the halos were attended on the first day, 46 per cent. were followed on the second day, and 38 per cent. were followed on the third day by rain or snow. On the Pacific coast halos were reported on thirteen dates; 38 per cent. of the halos were attended on the first day, 38 per cent. were followed on the second day, and 54 per cent. were followed on the third day by rain or snow. In New England and the middle Atlantic states, the Gulf States, and the Rocky Mountain and plateau regions 46 per cent. of the halos occurred in advance of, and 54 per cent. following, low pressure storms. In the south Atlantic states 62 per cent. of the halos occurred in advance of, and 38 per cent. following, low pressure storms. In the Mississippi and Ohio valleys 61 per cent. of the halos occurred in advance of, and 39 per cent. following, low pressure storms. In the Lake region 57 per cent. of the halos occurred in advance of, and 43 per cent. following, low pressure storms. In the Missouri Valley 78 per cent. of the halos occurred in advance of, and 22 per cent. following, low pressure storms. On the Pacific coast 15 per cent. of the halos occurred in advance of, and 85 per cent. following, low pressure storms.

PARHELIA.

At Milwaukee, Wis., parhelia were observed on the 1st at 9 a. m. Very bright spots exhibiting the prismatic colors appeared on each side, and equally distant about 20° from the sun, and nearly in the zenith was a segment of a circle showing the prismatic colors, with the convex side towards the sun. The parhelia lasted until 10.30 a. m. On the 1st high barometric pressure and fair weather prevailed over the region about Milwaukee. No rain fell on the 2d. On the 3d general rain prevailed over the Lake region. At Chicago, Ill., parhelia were observed at 9 p. m. of the 5th. A bright streak of light extended about 5° on each side of the moon and at right angles to the horizon. On a line parallel to the horizon were two spots, one on either side of the moon. The spots were small and highly colored, exhibiting the prismatic colors, and lasted about one hour. On the 5th high barometric pressure and fair weather prevailed over this region, which conditions were followed on the 6th and 7th by general rain.

METEORS.

Meteors of unusual brilliancy were not reported during the month. Meteors were reported as follows: 1st, Rugby, Tenn. 2d, Potsdam, N. Y.; Eagle's Mere, Pa. 5th, Vevay, Ind.; Rugby, Tenn. 6th, State College, Pa. 11th, Vevay, Ind.; Ohio State University, Ohio. 13th, Mantanzas, Fla.; Nashville and Rugby, Tenn. 16th, Detroit, Mich.; Cockrell, Ill. 17th, Fort Sully, S. Dak. 19th, Lacon, Ill.; Kansas City, Kans.; Kalamazoo, Mich.; Ozark, Mo. 20th, Vevay, Ind.; Barren Creek Springs, Md. 21st, Raleigh, N. C.; Ohio State University, Ohio. 22d, Leicester, Mass. 23d, Mount Angel, Oregon. 24th, Monticello, Iowa. 25th, Leicester, Mass. 28th, Coopersburgh, Pa. 30th, Mount Angel, Oregon; Taylor's Ranch, Utah.

MIRAGE.

Mirage were observed during the month as follows: 1st, Rolling Green, Minn. 3d, Hampton, Iowa. 6th, Saint Vincent, Minn. 11th, Woonsocket, S. Dak. 14th and 15th, Green Bay, Wis. 17th and 18th, Webster, S. Dak. 23d, Powder River, Mont. 25th, Woonsocket, S. Dak. 27th, Webster, S. Dak. 29th, Rolling Green, Minn.

Saint Vincent, Minn., 6th: the morning was perfectly clear in the east, and a remarkably beautiful sunrise showed a mirage, or what might more properly be termed a "looming." The ground, looking in an easterly direction, appeared to be lifted up several hundred feet, and objects such as trees, telegraph poles, etc., were plainly brought to view which on other occasions would be entirely shut off by the intervening rise of ground. A small one-story house estimated to be twenty-

five miles distant was plainly visible, and the smoke issuing from the chimney was also discernible. The phenomenon lasted from 8 a. m. to 9.30 a. m., when the eastern sky became obscured with cirrus-stratus clouds.

Green Bay, Wis.: a mirage was observed over the bay from 2 p. m. to 4 p. m., 14th. The horizon appeared much elevated, having the appearance of a long slope, and long stretches of shore on both sides of the bay were visible. The bay seemed one vast ice field with occasional stretches of clear water, although it was open as far as the eye could reach with the assistance of a good field-glass. A similar mirage was observed on the following day at about the same time, with the exception that there appeared to be more open water than on the previous day.

PRAIRIE AND FOREST FIRES.

Prairie fires were reported at Fort Sill, Ind. T., on the 11th, 16th, 28th, and 29th; at Fort Buford, N. Dak., on the 10th, 11th, 15th to 19th, 29th, and 30th; at Fort Sully, S. Dak., on the 10th, 12th, 13th, and 18th; at Fort Yates, S. Dak., on the 14th; at Wolsey, S. Dak., on the 9th and 10th; and brush fires were reported at La Crosse, Wis., 11th, 12th, and 13th.

Forest fires were reported near Plainfield, Conn., Concord, N. H., and Lakewood, N. J., on the 18th; near Southport, N. C., from the 12th to 15th; near Wilmington, N. C., 12th; and near Rapid City, S. Dak., on the 11th, 16th, 28th, and 29th.

SUN SPOTS.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.	Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.		
March, 1890.										
3, 11 a. m.	0	0	0	0	0	0	0	0	1	Definition poor.
4, 12 m.	1	5	0	0	0	0	1	5	0	Definition good.
5, 12 m.	0	0	0	0	0	0	1	5	0	Definition fair.
6, 4 p. m.	0	0	0	0	0	0	1	5	0	Definition fair.
7, 12 m.	0	0	0	0	0	0	1	5	0	Definition poor; three large spots.
8, 10 a. m.	0	8	0	0	0	0	1	10	0	Definition poor.
9, 5 p. m.	0	8	0	0	0	0	1	18	0	Definition fair; all small.
10, 10 a. m.	0	0	0	0	0	0	1	9	0	Definition poor; through clouds.
12, 11 a. m.	0	0	0	0	0	0	1	3	2	Definition fair.
13, 2 p. m.	0	0	0	0	0	0	1	3	2	Definition fair.
15, 3 p. m.	0	0	1	3	0	0	0	0	2	Definition fair.
16, 10 a. m.	0	0	0	0	0	0	0	3	2	Definition fair.
17, 10 a. m.	0	0	0	0	0	0	0	0	1	Definition fair.
18, 10 a. m.	0	0	0	0	0	0	0	0	3	Definition good.
20, 12 m.	0	0	0	0	0	0	0	0	1	Definition fair.
21, 3 p. m.	0	0	0	0	0	0	0	0	1	Definition fair.
23, 9 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
24, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
26, 9 a. m.	0	0	0	0	0	0	0	0	2	Definition fair.
27, 11 a. m.	0	0	0	0	0	0	0	0	0	Definition poor; through clouds.
28, 12 m.	0	0	0	0	0	0	0	0	2	Definition good.
29, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
30, 2 p. m.	0	0	0	0	0	0	0	0	0	Definition good.
April, 1890.										
1, 10 a. m.	0	0	0	0	0	0	0	0	1	Definition good.
2, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition fair.
3, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
4, 3 p. m.	0	0	0	0	0	0	0	0	0	Definition fair.
5, 9 a. m.	0	0	0	0	0	0	0	0	2	Definition good.
6, 10 a. m.	0	0	0	0	0	0	0	0	1	Definition fair.
7, 10 a. m.	0	0	0	0	0	0	0	0	1	Definition fair.
10, 9 a. m.	0	0	0	0	0	0	0	0	2	Definition good.
11, 12 m.	2	10	0	0	0	0	2	10	3	Definition fine; all small.
12, 10 a. m.	0	8	0	0	0	0	2	18	3	Definition fine.
13, 10 a. m.	0	0	0	0	0	0	2	11	3	Definition fine.
14, 10 a. m.	0	0	0	0	0	0	0	0	1	Definition good.
15, 11 a. m.	0	0	0	0	0	0	0	0	0	Definition very poor.
16, 9 a. m.	1	3	0	0	0	0	0	0	0	Definition fair; small.
17, 12 m.	0	0	0	0	0	0	0	0	2	Definition fair.
18, 5 p. m.	0	0	0	0	0	0	0	0	0	Definition fair.
19, 11 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
20, 12 m.	0	0	0	0	0	0	0	0	0	Definition fair.
21, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition fair.
22, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition poor.
23, 10 a. m.	0	0	0	0	0	0	0	0	0	Definition good.
26, 9 a. m.	1	3	0	0	0	0	1	3	0	Definition good; small.
29, 10 a. m.	0	16	0	0	0	0	1	19	0	Definition fine.
30, 11 a. m.	0	0	0	0	0	0	1	11	0	Definition fair.

Mr. C. E. Buzzell, Leaf River, Ill.: April 10th, one small group five days in, increasing on 11th, and disappeared on the 12th. 11th, small group, new, two days past meridian, in view on 12th; clouds, 13th, with clear disc on 14th. 28th, one small group observed through clouds. 29th, good definition, two small groups in north latitude two days west of meridian, with a trail of smaller spots connecting them; all were unchanged on the 30th, with clear disc on May 1st.

Mr. John W. James, Riley, Ill.: none seen until 29th, then a group of small spots, about one-half day past sun's meridian.

Mr. M. A. Veeder, Lyons, N. Y.: 1st and 2d, faculae appeared by rotation, spots forming in their vicinity on 10th, and fading out again by 14th, the faculae alone being seen on the eastern limb, 15th. Faint faculae near the eastern limb, 5th and 11th. On the 22d faculae appeared by rotation, and on the 28th spots had formed in their vicinity, continuing with many changes until the end of the month. Observations were poor or lacking on 4th, 8th, 9th, 13th, 23d, and 27th.

H. D. Govey, North Lewisburgh, Ohio: sun spots were observed on the 12th and 30th.

VERIFICATIONS.

FORECASTS FOR 24 HOURS IN ADVANCE.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

The forecasts for districts east of the Rocky Mountains for April, 1890, were made by 1st Lieutenant Richard E. Thompson, 6th Infantry, Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps.

Percentages of forecasts verified, April, 1890.

States.		States.	
Maine.....	74.8	Kentucky.....	82.1
New Hampshire.....	72.7	Ohio.....	74.9
Vermont.....	73.9	West Virginia.....	76.9
Massachusetts.....	76.4	Indiana.....	80.5
Rhode Island.....	75.5	Illinois.....	83.0
Connecticut.....	73.1	Lower Michigan.....	80.0
Eastern New York.....	81.1	Upper Michigan.....	78.6
Western New York.....	78.9	Wisconsin.....	78.5
Eastern Pennsylvania.....	78.0	Minnesota.....	80.1
Western Pennsylvania.....	77.5	Iowa.....	80.7
New Jersey.....	76.7	Kansas.....	71.2
Delaware.....	76.5	Nebraska.....	76.6
Maryland.....	77.1	Missouri.....	70.9
District of Columbia.....	78.2	Colorado.....	81.2
Virginia.....	79.7	North Dakota.....	85.9
North Carolina.....	80.3	South Dakota.....	85.3
South Carolina.....	80.2	Southern California*.....	87.7
Georgia.....	77.7	Northern California*.....	85.1
Eastern Florida.....	85.0	Oregon*.....	81.7
Western Florida.....	93.9	Washington*.....	75.9
Alabama.....	82.9	By elements: Weather.....	83.5
Mississippi.....	79.9	Temperature.....	71.7
Louisiana.....	77.3	Monthly percentage of weather and	
Texas.....	78.0	temperature combined.....	78.8
Arkansas.....	78.0		
Tennessee.....	79.5		

*In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. †The forecasts of temperature in districts east of the Rocky Mountains for April, 1890, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

FORECASTS FOR 48 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for forty-eight and seventy-two hours, cov-

ering the second and third days in advance. Such forecasts are optional with the predicting officer, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 86; temperature, 42. Percentages of verifications: weather, 86.9; temperature, 77.4. Weather and temperature combined, 84.3.

No forecasts for seventy-two hours were made during the month.

CAUTIONARY SIGNALS FOR APRIL, 1890.

Statement showing percentages of justifications of wind signals for the month of April, 1890:

Wind signals.—(Ordered by Lieutenant Richard E. Thompson.) Total number of signals ordered, sixty-nine; justified as to velocity, wholly, forty-three, partly, two; justified as to direction, sixty-six. Of the signals ordered, fifty-five were cautionary signals, of which thirty-four were wholly, and one partly justified, and fourteen were storm signals, of which nine were wholly, and one partly justified. Thirty-four signals were ordered for easterly winds, of which thirty-three were justified, and thirty-five were ordered for westerly winds, of which thirty-three were justified. Percentage of justifications, 68.0.

Cold-wave signals.—(Ordered by Assistant Professor T. Russell.) Total number of signals ordered, thirty-three; justified, thirteen. Percentage of justifications, 39.4.

Percentages of verifications of weather and temperature signals reported by directors of the various State Weather Services for April, 1890.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois.....	82.0	76.6	Nebraska.....	84.9	87.2
Indiana.....	79.0	83.0	New Jersey.....	87.5	88.8
Kansas.....	82.6	84.2	New York.....	86.5	85.2
Kentucky.....	91.0	90.0	Ohio.....	82.0	88.0
Michigan.....	88.5	85.5	Pennsylvania.....	83.0	89.0
Minnesota.....	74.0	78.0	South Carolina.....	84.9	90.6
Missouri.....	76.0				

STATE WEATHER SERVICES.

[Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.]

The following extracts and summaries are republished from reports for April, 1890, of the directors of the various state weather services:

ALABAMA.

Temperature.—Highest monthly mean, 68.8, at Citronelle; lowest monthly mean, 61.5, at Valley Head; maximum, 89, at Wiggins, 15th; minimum, 31, at Elkmont, 4th and 11th; greatest local monthly range, 53, at Guntersville and Wiggins; least local monthly range, 29, at Union Springs.

Precipitation.—Greatest monthly, 5.94, at Carrollton; least monthly, 1.20, at Mount Willing.

Wind.—Prevailing direction, southwest.—P. H. Mell, Signal Corps, Auburn, director.

ARKANSAS.

Temperature.—The average was about 2 below the normal; maximum, 93,

at Lead Hill; minimum, 33, at Ozone. A number of stations reported light frost on the 10th; no damage except to delicate plants.

Precipitation.—The average was 6.51 in excess of the normal of the past three years; greatest monthly, 12.95, at Hot Springs; least monthly, 5.71, at Lead Hill.—M. F. Locke, Commissioner of Agriculture, Little Rock, director; W. U. Simons, Sergeant, Signal Corps, assistant.

COLORADO.

Temperature.—The mean was about 0.5 below the normal; highest monthly mean, 53.9, at Fruita; lowest monthly mean, 25.9, at Climax; maximum, 88, at Lamar, 11th; minimum, —3, at Climax, 8th; greatest local monthly range, 69, at Thon; least local monthly range, 41, at Alma.